ECOHYDROLOGICAL MODELING OF GRASS LAND-SHRED-TRUBE DYNAMICS IN THE SEVILLA NEATION WILDLIFE REFUGE

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OBJECTIVE

Andi oasis and transition regions are extremely diverse in terms of their geology, topography and ecosystems. Since water availability is a dominant factor in these systems, obtaining accurate information of the water balance parameters is significant for understanding the interaction between the land surface and atmosphere over a range of space and time scales. The objective of this study is to develop an analytical water balance model introduced by Loa et al. (2001) to investigate the relationship between the hydrologic parameters soil, vegetation and precipitation and the soil moisture, runoff, deep percolation and evapotranspiration in the Sevilleta National Wildlife Refuge (SNWR). The effect of different types of soil, vegetation and distribution of precipitation on soil moisture and evapotranspiration parameters will be addressed. The relative importance of soil and vegetation properties will be evaluated in the context of point and spatial hydrologic output. From the model results, we will infer how the interaction between climate, soil types and vegetation lead to the coexistence of grasses, shrubs and trees in the region. Finally, the implications of the model and possible extensions will be examined.

METHOD AND MATERIALS

Soil, vegetation types and historical daily rainfall data (1990 - 2003) over the study area were obtained at the Sevilleta LTER website (http://soils.stanford.edu/soildata.html). Soil, vegetation and rainfall information have been generalized into a reduced number of general classes in order to extract eighty-six (86) different combinations (Figure 2). Structural soil moisture model was applied over the SNWR domain by assuming an independent set of grid cells to obtain the spatial pattern of the water balance components.

Figure 2. Vegetation-soil rainfall index (vegetation*soil*rainfall = rainfall)

Potential ET (ETP) can be related to the type of vegetation by using different thresholds below which no water reaches the ground.

Rainfall ET (ETR) is the ETP (the amount of water in the soil water content and the amount of albedo of the water content reaches the ET P range limit (Reddington et al., 2000).

Leakage (L) occurs at the bottom of the soil layer and is expressed as the ratio of potential outflow. It occurs at a rate set by the soil water content and is a function of the water content reaches the ET P range limit (Reddington et al., 2000).

RUNOFF (Q) occurs when the amount of infiltration exceeds the available storage, the excess is converted to surface runoff. ET_P < 0, Q_t < 0 = Q_t = (Q_T + L) + L [2]

RESULTS AND INTERPRETATIONS

Spatial results

A total of 86 different vegetation-soil, rainfall-infiltration combinations occur in study area and all of the individual combinations are needed to analyze soil moisture and water balance parameters ET, rainfall and leakage.

Mean daily soil moisture saturation (P8) is strongly correlated with soil texture since fine-texture soil can hold water at higher tension, and therefore, stay wetter than coarse texture soil throughout the simulation time.

MODL: Description

The model used in this study is to assess the soil moisture balance at a point, and its components are defined as follows:

where, c(T) = 1/10(T1) - (T2) = 82009.5, and c(T) = E/T0(T0) = 10(T2) - (T0) + (T0)(Z), where, Z is the storage capacity, Z is the depth of root zone, Z is the degree of saturation at Z, Z is the infiltration, (T) is the soil moisture storage, X(T) is the infiltration, Z(T) is the interception, Q(T) is the rainfall, F(T) is the transpiration, and X(T) is the leakage.

The model results show that the effect of vegetation, soil and rainfall on ET and soil moisture. As such, the amount of ET and soil moisture is related by the same factors. In particular, low ET and soil moisture of surface areas are explained by the low soil moisture capacity. The distribution of ET and soil moisture (Figure 4) show that highest frequency occurs 18-36 in ET, 0-10 in ET, 0-10 in soil moisture, and 10-20 in soil moisture. These indicate that amount of ET is close to the water of precipitation by interception and soil moisture storage is very dry in this study area. In addition, the two peaks in soil moisture distribution occur because of precipitation and soil moisture storage during periods with low ET.